§2. Study of Impurity Ion Radiation Intensity in the GAMMA 10 Plasma

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Time- and space-resolved spectroscopic measurements of impurity ion radiation spectra give us a lot of important information, such as time and space variations of plasma density, electron and ion temperatures, etc. After comparing the collisional-radiative model (CR-model)[1] calculation results for impurity ion line radiation intensities and those measured by spectroscopic method, we can obtain the impurity ion densities, electron density and temperatures. The aim of this study is to construct the database for plasma spectroscopic diagnostics in the fusion plasmas.

CR-model calculation codes for carbon and oxygen ions developed at NIFS were used in this study.[1] These codes include the efficiencies for electron impact ionization, excitation, recombination and de-excitation. In the previous reports,[2-4] we used CR-model calculation code for CII and CIII ions in order to obtain the time dependent CII and CIII ion density radial distributions. We calculated the CR-models for CIV and CV. Then we find that there must be C^{+3} and C^{+4} ions in the GAMMA 10 plasma in the core region. Then we set a VUV spectrometer, which can observe the wavelength range from 50 to 450 nm, in GAMMA 10.

When we will develop the CR-model for each ion species, we have to include the energy levels and transition probabilities of collision cross sections. We used flexible atomic code (FAC) developed by M. F. Gu.[5] FAC is free software. We calculated the electron impact excitation and ionization cross sections with FAC. We have to evaluate the results of FAC calculation to the database at NIST in order to use the results of FAC for CR-models. Figure 1 shows the comparison of energy levels between FAC calculation results and the NIST data in CII. Figure 2 shows the comparison of transition rates between FAC and NIST. These results show that the FAC is a good agreement with the NIST data within 10 % of error. Then we use the FAC calculation code in order to obtain the energy levels and transition probabilities of collision cross sections for CR-models.

Reference

1) Kato, T., et al.: Fusion Eng. Des., **34-35** (1997) 789.
2) Yoshikawa, M., et al.: Annual Report of NIFS, April 2000-March 2001 (2001) 388.
3) Yoshikawa, M., et al.: Annual Report of NIFS, April 2001-March 2002 (2002) 374.
4) Yoshikawa, M., et al.: Annual Report of NIFS, April 2002-March 2003 (2003) 380.
5) M. F. Gu: ApJ., 582 (2003) 1241.

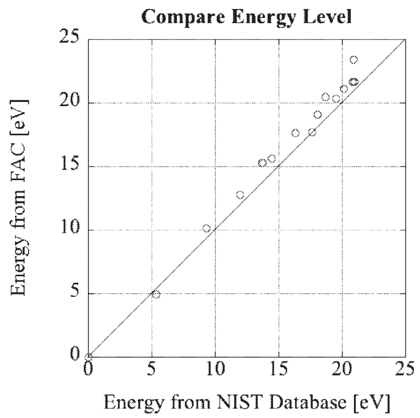

Fig. 1: Comparison between energy levels from NIST and FAC.

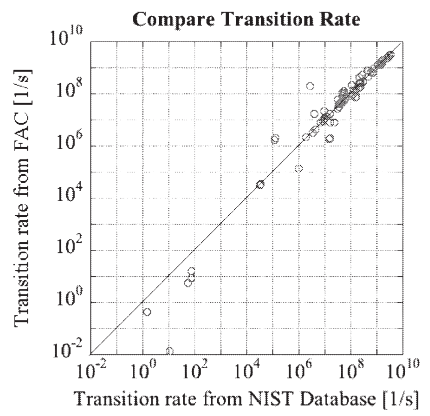

Fig. 2: Comparison between transition rates from NIST and FAC.